BIOLOGICAL EVALUATION OF THE MOUNTAIN PINE BEETLE OUTBREAK IN YELLOWSTONE NATIONAL PARK 1968

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This report is designed to provide information on the status of the mountain pine beetle epidemic in the southwestern corner of Yellowstone National Park. It was prepared from information collected on the neighboring Targhee National Forest and from information collected during our mountain pine beetle cruise conducted in the Bechler area. Our initial plan was to send you a separate evaluation and a separate report of our cruise findings; however, since the data collected during the cruise can be used to predict future mountain pine beetle activity, it was used to complement the evaluation of the beetle situation in the Bechler area.

We appreciate your November 12 letter of endorsement of our mountain pine beetle study in the Bechler area. This provides us with the opportunity of studying some aspects of the population dynamics of this important insect pest in an undisturbed environment.

Specifics on objectives, methods, location of cruise, etc., were included in our October 29 letter to Dr. William Hendrickson. Briefly, the objectives of the cruise were as follows:

1. To determine lodgepole pine mortality by diameter class on a yearly basis from the beginning to the end of the current infestation; and

2. To determine the green stand structure before, during, and at the end of the infestation.

The cruise was limited to a 1-square-mile area (2 miles x $\frac{1}{2}$ mile) in the extreme southwest corner of the Park. Eighty-five plots were established at 10-chain intervals within the survey area. Green stand data were taken from 27 of the plots and mortality was recorded on all 85 plots. The variable plot method of cruising was used with a basal area factor (BAF) of ten used for green stand plots and a BAF of five used for mortality counts.

Our cruise data, as shown in the following table, indicate that the green stand structure has not changed materially from the beginning of the infestation to the present. Totally there were 438 live lodgepole pine per acre in 1965 and 410 in 1968 (see figure 1).

NUMBER OF TREES PER ACRE

	D.B.H. (2" classes)								
	4	6	8	10	12	14	16	>16	
Year									Total
1965	222	79.9	63.7	42.1	17.0	8.4	2.3	2.3	437.7
1968	222	79.0	57.8	34.0	12.2	3.7	.8	.8	410.3

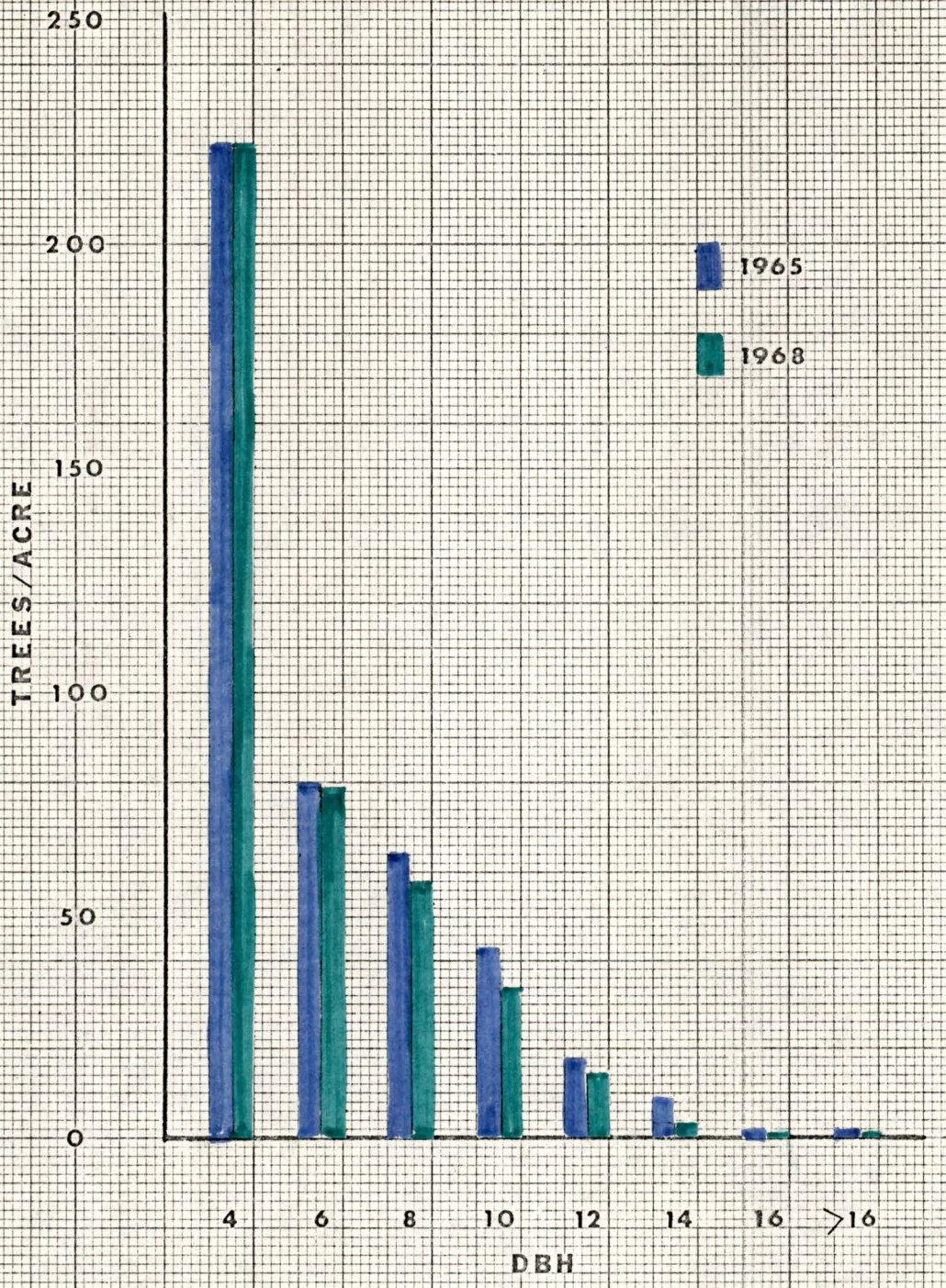

Figure 1 - Comparison of lodgepole pine stand structure in the Bechler area between 1965 and 1968.

A breakdown of tree mortality by 2-inch diameter classes shows that a greater percentage of large diameter trees have been lost. This information is summarized in the following table and in figure 2.

PERCENT MORTALITY

	D.B.H. (2" classes)							
	4	6	8	10	12	14	16	>16	
Year									Total
1966	-	.4	1.3	1.8	2.8	5.7	12.2	12.8	100
1967	-	-	1.1	2.6	6.0	15.0	14.0	14.1	100
1968	-	.8	6.9	16.0	19.1	34.9	38.4	37.1	100
Total	-	1.2	9.3	20.4	27.9	55.6	64.6	64.0	

Trees in the larger diameter classes comprise only a small proportion of the stand, and subsequently only a few trees per acre have been lost in the 14-inch and above diameter classes. A greater number of trees, as shown in the following table, have been lost in the smaller diameter classes. This information is also portrayed in figure 3.

MORTALITY BY TREES PER ACRE

	4	6	8	10	12	14	16	>16	
Year									Total
1966	-	.3	.9	.8	.5	.5	.3	.3	3.6
1967	-	-	.7	1.1	1.0	1.3	.3	.3	4.7
1968	-	.6	4.4	6.8	3.2	2.9	.9	.9	19.7
Total	-	.9	6.0	8.7	4.7	4.7	1.5	1.5	28.0

Data concerning unsuccessful attacks were taken during the cruise; and after computations, it was found that there was a total of 4.8 current pitchouts per acre. A pitchout, incidentally, is a tree that has overcome attacks. A summary of these data follows:

NUMBER OF PITCHOUTS PER ACRE (1968)

D.B.H. (2" classes)								
4	6	8	10	12	14	16	>16	
								Total
-	.3	1.71	1.98	.6	.18	-	-	4.77

Additionally, there were .8 current strip attacks per acre, as shown in the following table. A strip attack is a tree that has been successfully attacked over only a portion of the stem. Beetles did not attack or were pitched out of the remaining portion of the stem.

NUMBER OF STRIP ATTACKS PER ACRE (1968)

D.B.H. (2" classes)								
4	6	8	10	12	14	16	>16	
								Total
-	-	.17	.44	.06	.06	-	.06	.79

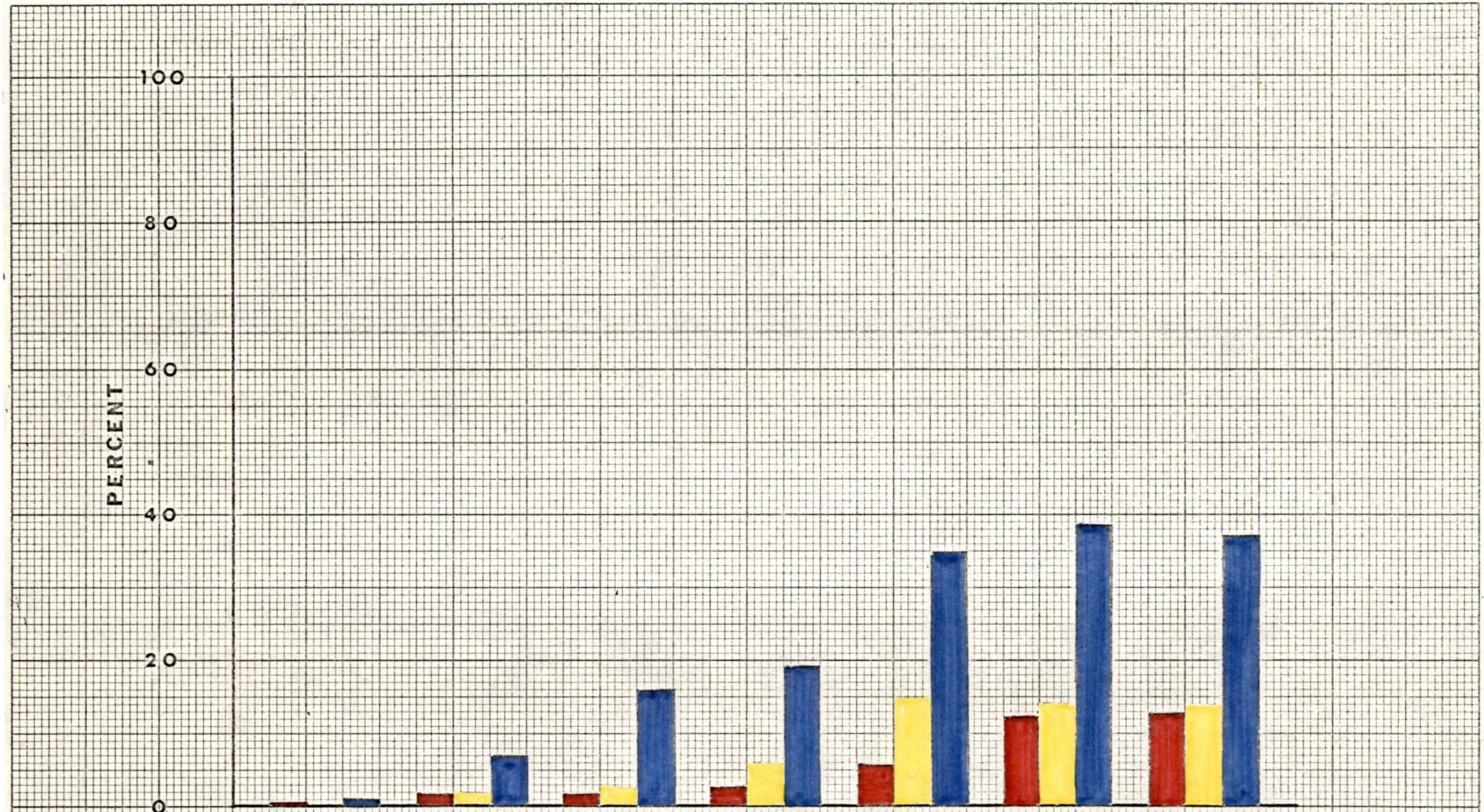

Figure 2 - Percent of lodgepole pine mortality in the Bechler area by year and 2-inch diameter classes.

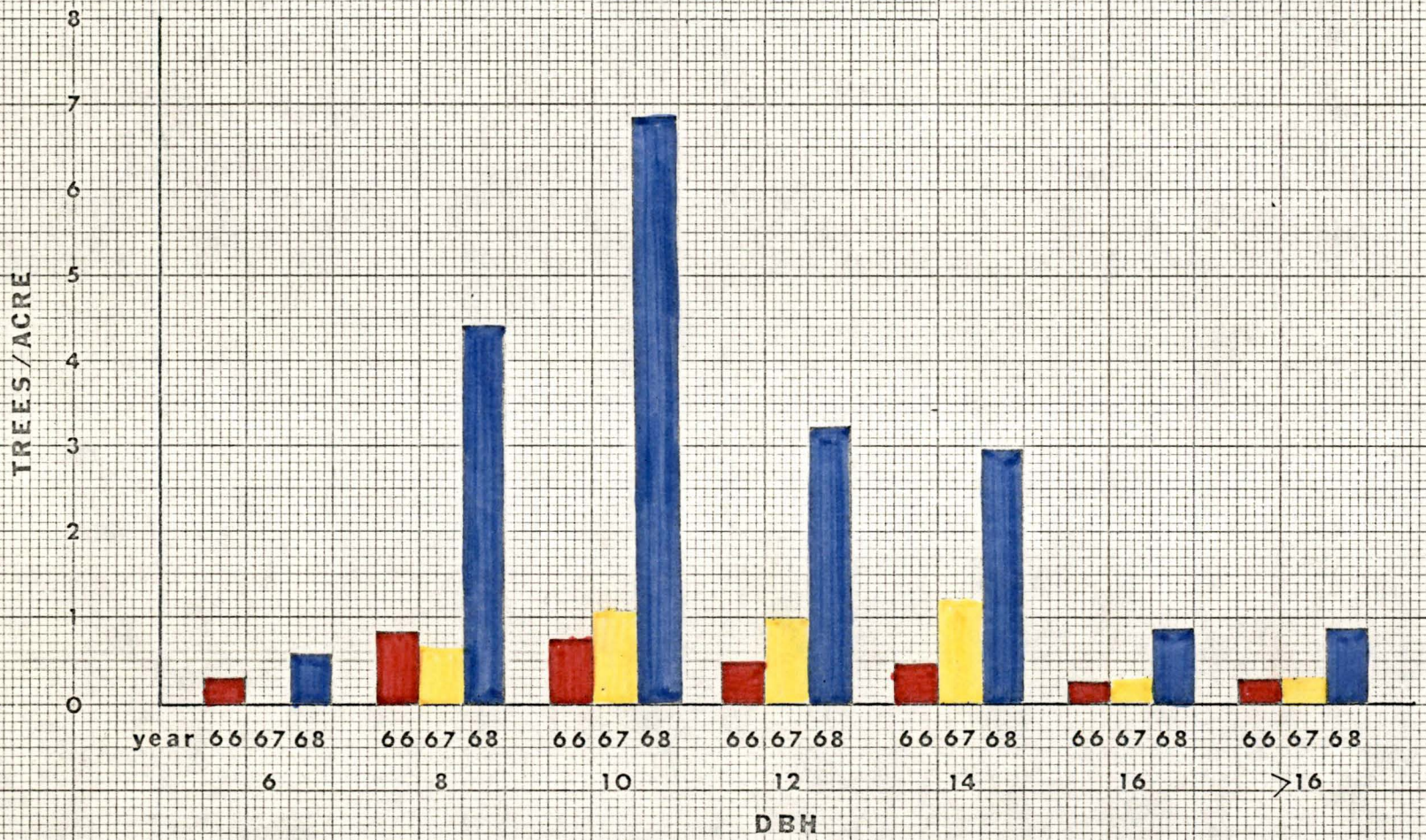

Figure 3 - Number of lodgepole pine killed per acre in the Bechler area by year and 2-inch diameter classes.

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A summary of the statistical analysis for the number of trees per plot for both green stand and mortality data follows:

Plots	Mean (X) Per Plot	Variance (s^2)	Confidence Interval for Mean (95% level)
Green Stand	7.67	5.68	$\pm$ 2.24
Mortality	4.27	3.63	$\pm$ 0.78

Historically, the outbreak in the Park is part of a general infestation that extends onto the neighboring Targhee National Forest. The infestation started on the Forest in the early 1960's and reached significant proportions in 1964. Control was initiated in 1965, and even though this effort most probably reduced tree losses and slowed the spread of the infestation, the epidemic continued to increase. The infestation spread into the Park and reached concernful proportions in 1966. In 1967, the infestation covered 6,000 acres and extended from Winegar Lake west to the Park boundary and north to Robinson Lake. The heaviest tree killing occurred along the south boundary of the Park and decreased in intensity to the north. A systematic survey conducted by Yellowstone Park personnel showed that there were slightly more than 18,000 infested trees spread over the 6,000 acres. In 1968, a similar survey, though less intensive, showed that the infestation had increased in intensity and had moved further north. An estimated 265,000 infested trees were found over an area of 58,600 acres. Averaged figures of the number of trees per acre showed that there were 0.75 newly attacked trees in 1966, and 3.09 and 19.08 trees per acre in 1967 and 1968, respectively. These figures average out to a 4 to 1 buildup ratio between 1966 and 1967 and a 6 to 1 buildup ratio between 1967 and 1968.

All of the information available to us at this time points toward a population increase. The epidemic should increase in intensity within the presently infested areas and new activity should appear in beetle-free areas to the north and east.

Our data indicate that stand conditions are favorable for continued activity. Even in the hardest hit areas in the southwestern corner, many trees of susceptible size remain. Over 50 percent of the trees 14 inches in diameter and above have been killed in the area; however, trees in these diameter classes constitute only a small proportion of the stand. Trees in the 8 to 12 inch diameter classes make up a larger percentage of the stand and these trees are more frequently being attacked and subsequently are providing the impetus to the infestation. Since beetle activity decreases in areas to the north, it is reasonable to assume that stand conditions are even more favorable for a buildup.

Numerous references in the entomological literature and elsewhere state that all trees 3 inches in diameter and above can be lost during a mountain pine

beetle epidemic. Obviously this is not, and has not been, the case in Yellowstone National Park or on the Targhee National Forest. We must understand that the underlying cause of this or any other mountain pine beetle epidemic is the presence of contiguous, even-aged stands of mature and overmature lodgepole pine. When this condition prevails, as it has in the Park and on the Forest, a mountain pine beetle epidemic will surely follow. In looking back through old records, we found that there were extensive epidemics in the Park and on the Forest from 1928 to 1939, and again from 1948 to 1953. If all trees 3 inches in diameter and above had been killed during any one of these epidemics, none of the other infestations could have begun. It should be apparent that, even after these past extensive beetle epidemics, a major percentage of the original stand was not affected.

On the other hand, losses incurred during an epidemic can be considered as being serious. Our cruise data show that over 50 percent of the trees 14 inches in diameter and above have been killed and a larger percentage will be lost before the infestation is over. Even though trees in these diameter classes constitute a small proportion of the stand, they hold a major portion of the volume of merchantable timber. We definitely consider such a loss significant; however, we believe it important to put the overall situation in perspective with regard to the percentage or number of trees lost during an epidemic.

As you know, buildup ratios are used to predict future bark beetle activity, and they provide an index to the magnitude of future trends. The buildup ratios in the Park were 4:1 from 1966 to 1967 and 6:1 between 1967 and 1968. Even though these ratios were high, it must be realized that the number of infested trees per acre was low. The ratio of new to old attacks will have to decrease as the number of infested trees increase, because the cumulative number of dead trees would rapidly exceed original stocking levels if the ratios remained high. We know, from what little information we have, that the mountain pine beetle rarely depletes over 30 percent of the stand. This percentage can be higher in isolated areas, but the overall loss averages around 30 percent. Presently, approximately 6.4 percent of the stand within the area we cruised has been killed. If the ratio would be 5:1 next year, slightly over 30 percent of the stand would be lost, and the beetle population would probably collapse. We are of the opinion that the ratio will be lower and the infestation will continue over a period of several years.

The Targhee National Forest in the past several years has made an effort to control the mountain pine beetle infestation on lands adjacent to the Park. A proposal has been submitted to gain funds for further efforts; however, approval for the project as of yet has not been received, and may never materialize. This being the case, the infestation on the Forest should increase. Even if approval is received, not all infestations on the Forest surrounding the Park will be included in the control area, and beetle invasion from the Forest will add to the problem in the Park.

Since the infestation in the Park has been allowed to proceed unchecked to its present high level, it would be difficult, if not impossible, to control the epidemic.

Thank you for your interest and help in our study. We look forward to continuing the effort until the infestation subsides. We plan to send you an up-to-date summary of our findings each year following the completion of the survey. Additionally, a final report will be forwarded to you after the infestation subsides.

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